

WHAT IS CLAIMED IS:

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1. A measuring system for measuring performance of an imaging optical system by use of an interferometer, said measuring system comprising:

5 an interferometer arranged to measure transmission wavefronts separately or sequentially, in relation to at least one of plural measurement points defined along a plane perpendicular to an optical axis of the imaging optical system, wherein position coordinates of object side and image side imaging points of the  
10 plural measurement points are measured; and  
a computing unit being communicated with said interferometer, said computing unit being operable to calculate a wavefront as measured by said interferometer and at least one of a wavefront aberration and an imaging state of the imaging  
15 optical system, and said computing unit being operable to correct a measured value related to at least one of a wavefront aberration and an imaging state of the imaging optical system at another measurement point, while taking, as a reference, at least one of a wavefront aberration and an imaging state at a standard point  
20 set along a plane perpendicular to the optical axis.

2. A measuring system according to Claim 1, wherein the measurement of a transmission wavefront and position coordinates with respect to the standard point is performed plural times more  
25 than the measurement of the transmission wavefront and position coordinates with respect to another measurement point.

3. A measuring system according to Claim 2, wherein  
measurement of the transmission wavefront and position coordinates  
with respect to the standard point is performed simultaneously and  
every time the measurement of the transmission wavefront and  
5 position coordinates with respect to another measurement point is  
performed.

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10 4. A measuring system according to Claim 1, wherein the  
standard point is an object point and an image point on the optical  
axis of the imaging optical system.

15 5. A measuring system according to Claim 1, wherein the  
position coordinates of the measurement point concern a relative  
coordinate system with respect to the position coordinates of the  
standard point.

20 6. A measuring system according to Claim 1, wherein an  
optical system for measurement of the standard point is provided  
separately from an optical system for measurement of the other  
measurement point.

25 7. A measuring system according to Claim 6, wherein the  
optical system for measurement of the other measurement point is  
movable at the object plane side and the image plane side and it  
has a laser interferometer for monitoring the position coordinates  
thereof.

8. A measuring system according to Claim 6, wherein there are optical systems for measurement of the other measuring points, the number of which corresponds to the number of the measurement points.

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9. A measuring system according to Claim 1, wherein the measurement with respect to the standard point and the other measurement points is carried out by use of one and the same optical system.

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10. A measuring system according to Claim 9, the same optical system for measurement of the standard point and the measurement point is movable at the object plane side and the image plane side, and there is a laser interferometer for monitoring the moved position coordinates.

11. A measuring system according to Claim 1, wherein, in an optical system for the other measurement point, a chief ray of light impinging on the measurement points is registered with a direction of a chief ray of the imaging optical system.

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12. A measuring system according to Claim 1, wherein the imaging state includes distortion and curvature of field.

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13. A projection exposure apparatus for performing projection exposure by use of an imaging optical system, said apparatus comprising:

an imaging optical system;  
an interferometer arranged to measure transmission  
wavefronts separately or sequentially, in relation to at least one  
of plural measurement points defined along a plane perpendicular  
5 to an optical axis of the imaging optical system, wherein position  
coordinates of object side and image side imaging points of the  
plural measurement points are measured; and

10 a computing unit being communicated with said  
interferometer, said computing unit being operable to calculate  
a wavefront as measured by said interferometer and at least one  
of a wavefront aberration and an imaging state of the imaging  
optical system, and said computing unit being operable to correct  
a measured value related to at least one of a wavefront aberration  
and an imaging state of the imaging optical system at another  
15 measurement point, while taking, as a reference, at least one of  
a wavefront aberration and an imaging state at a standard point  
set along a plane perpendicular to the optical axis.

14. A measuring system for measuring performance of an  
20 imaging optical system, comprising:

an interferometer arranged to measure transmission  
wavefronts separately or sequentially, in relation to at least one  
of plural measurement points defined along a plane perpendicular  
to an optical axis of the imaging optical system, wherein position  
25 coordinates of object side and image side imaging points of the  
plural measurement points are measured; and  
a computing unit being communicated with said

interferometer, said computing unit being operable to calculate a wavefront as measured by said interferometer and at least one of a wavefront aberration and an imaging state of the imaging optical system, and said computing unit being operable to correct 5 at least one of distortion and a focal plane at another measurement point of the imaging optical system, while taking, as a reference, at least one of distortion and a focal plane at a standard point set along a plane perpendicular to the optical axis.

10 15. A measuring system according to Claim 14, wherein a result of measurement of distortion and focal plane with respect to the other measurement point is complemented on the basis of a result of measurement made plural times to the distortion and the focal plane with respect to the standard point.

15 16. A measuring system according to Claim 14, wherein the standard point is an object point and an image point on the optical axis of the imaging optical system.

20 17. A measuring system according to Claim 14, wherein the position coordinates of the measurement point concern a relative coordinate system with respect to the position coordinates of the standard point.

25 18. A measuring system according to Claim 14, wherein correction of a change of distortion and focal plane with respect to time is carried out by subtracting the amount of change from

the measured values of them.

19. A measuring system according to Claim 14, wherein an optical system for measurement of the standard point is provided  
5 separately from an optical system for measurement of the other measurement point.

20. A measuring system according to Claim 19, wherein the optical system for measurement of the other measurement point is  
10 movable at the object plane side and the image plane side and it has a laser interferometer for monitoring the position coordinates thereof.

21. A measuring system according to Claim 19, wherein  
15 there are optical system for the other measurement points, of a number the same as the measurement points.

22. A measuring system according to Claim 14, wherein the measurement with respect to the standard point and the other  
20 measurement points is carried out by use of one and the same optical system.

23. A measuring system according to Claim 21, the same optical system for measurement of the standard point and the  
25 measurement point is movable at the object plane side and the image plane side, and there is a laser interferometer for monitoring the moved position coordinates.

24. A measuring system according to Claim 14, wherein, in an optical system for the other measurement point, a chief ray of light impinging on the measurement points is registered with 5 a direction of a chief ray of the imaging optical system.

25. A projection exposure apparatus for performing projection exposure by use of an imaging optical system, said apparatus comprising:

10 an imaging optical system;  
an interferometer arranged to measure transmission wavefronts separately or sequentially, in relation to at least one of plural measurement points defined along a plane perpendicular to an optical axis of the imaging optical system, wherein position 15 coordinates of object side and image side imaging points of the plural measurement points are measured; and  
a computing unit being communicated with said interferometer, said computing unit being operable to calculate a wavefront as measured by said interferometer and at least one 20 of a wavefront aberration and an imaging state of the imaging optical system, and said computing unit being operable to correct at least one of distortion and a focal plane at another measurement point of the imaging optical system, while taking, as a reference, at least one of distortion and a focal plane at a standard point 25 set along a plane perpendicular to the optical axis.

26. A method of measuring performance of an imaging

optical system by use of an interferometer, said method comprising the steps of:

measuring, by use of the interferometer, transmission wavefronts separately or sequentially, in relation to at least one of plural measurement points defined along a plane perpendicular to an optical axis of the imaging optical system, wherein position coordinates of object side and image side imaging points of the plural measurement points are measured;

calculating a wavefront as measured by the interferometer and at least one of a wavefront aberration and an imaging state of the imaging optical system; and

correcting a measured value related to at least one of a wavefront aberration and an imaging state of the imaging optical system at another measurement point, while taking, as a reference, at least one of a wavefront aberration and an imaging state at a standard point set along a plane perpendicular to the optical axis.

27. A method of measuring performance of an imaging optical system by use of an interferometer, said method comprising the steps of:

measuring, by use of the interferometer, transmission wavefronts separately or sequentially, in relation to at least one of plural measurement points defined along a plane perpendicular to an optical axis of the imaging optical system, wherein position coordinates of object side and image side imaging points of the plural measurement points are measured;

calculating a wavefront as measured by said interferometer

and at least one of a wavefront aberration and an imaging state of the imaging optical system; and

correcting at least one of distortion and a focal plane at another measurement point of the imaging optical system, while taking, as a reference, at least one of distortion and a focal plane at a standard point set along a plane perpendicular to the optical axis.

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